AUTOLOGOUS STEM CELL TRANSPLANTATION

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Emsey Hospital
Istanbul
Hematopoietic stem cell transplantation (HSCT) is the transplantation of multipotent hematopoietic stem cells:
- bone marrow,
- peripheral blood,
- umbilical cord blood.
• Georges Mathé, performed the first European bone marrow transplant in 1959 on five Yugoslavian nuclear workers whose own marrow had been damaged by irradiation caused by a Criticality accident at the Vinča Nuclear Institute.

• Mathé later pioneered the use of bone marrow transplants in the treatment of leukemia.
• Fred Hutchinson Cancer Research Center from the 1950s through the 1970s led by E. Donnall Thomas (Nobel Prize).
Adult Stem Cells

- Replenish cells lost through age or injury
- Largest reservoir in marrow
  - Stem cells circulate in blood
  - “Relocate” to fill empty stem cell slots in other tissues
- Harvested from bone marrow or peripheral blood in stem cell transplants since late 1970’s
- Stem cells isolated from:
  - Skin, brain, prostate, muscle
Indications for Stem Cell Transplants

- **Cancer:**
  - Leukemia
  - Myelodysplasia
  - Lymphoma
  - Breast cancer
  - Testicular cancer
  - Ovarian cancer
  - Brain tumors
  - Pediatric tumors
  - Multiple myelomas
  - Sarcomas
  - Kidney cancers

- **Non Cancers:**
  - Autoimmune diseases
    - Rheumatoid arthritis
      - Juvenile and adult
    - Multiple Sclerosis
    - Scleroderma
    - Systemic Lupus
  - Immune deficiency
  - Sickle cell anemia
  - Thalassemia
• Two main types based on source of stem cells
  • **Autologous**: no immunologic conflict
    • Stem cell infusion as “rescue” from high dose chemo
      • “marrow lethal dose”
  • **Allogeneic**: Minor HLA disparity
    • Related
    • Unrelated
    • Cord blood
      • High dose therapy with immunotherapy
        • “rejection” of the cancer and building better immunity
• Adult stem cells obtained by large volume marrow biopsy/aspiration (1-2L)
• Cord blood stem cells obtained at delivery by sterile emptying umbilical cord and placenta into blood donation bag
• Increasingly obtained by processing of peripheral blood of patients and healthy donors
  • Isolated in “real time” from blood after stimulation with blood cell growth factors
• Stem cells can be frozen for up to 5-10 years
Complications of Autologous Stem Cell Transplantation

- Toxicities due to preparative regimens
  - Chemotherapy drugs
  - Radiotherapy
- Infections
  - Bacterial
  - Viral
  - Fungal
- Bleeding and anemia
- Relapse of the primary disease
Transplant Activity in the U.S.
1980-2011
• Autologous Transplant
  • No evidence of disease in the blood or bone marrow
  • Transplant related mortality (TRM) lowest with autos (<5%)
  • Relapse rates are higher depending on the disease
  • Absence of graft versus tumor effects

Graft Sources
Autologous Stem Cell Sources by Recipient Age, 2001-2010

Transplants, %

- Bone Marrow (BM)
- Peripheral Blood (PB)
- BM + PB

Age ≤ 20 yrs

- 2001-2005
- 2006-2010

Age > 20 yrs

- 2001-2005
- 2006-2010
Trends in Transplants by Type and Recipient Age*
2001-2010

* Transplants for AML, ALL, NHL, Hodgkin Disease, Multiple Myeloma
Trends in Transplants by Transplant Type and Recipient Age*
1990-2010

* Transplants for AML, ALL, NHL, Hodgkin Disease, Multiple Myeloma
Indications for Hematopoietic Stem Cell Transplants in the United States, 2010
(Inflation factor: Auto=1.25 (80%), Allo=1.05 (95%), All Transplants)
• Multiple myeloma
• NHL
• Hodgkin’s disease
• AML
• Neuroblastoma
• Ovarian cancer
• Germ-cell tumors
• Autoimmune disorders
• Amyloidosis

Indications Autologous Transplant

Copelan EA. Hematopoietic stem-cell transplantation. NEJM 2006;354:1813-1826.
• Bone Marrow Harvest
  • General anesthesia
  • Equivalent of 50-100 bone marrow biopsies
  • Used much less often
  • 2 deaths in 8000 collections

Copelan EA. Hematopoietic stem-cell transplantation. NEJM 2006;354:1813-1826.

Figure 2. The posterior iliac crests (arrows) are common sites for bone marrow aspiration and biopsy

Maslak, P. ASH Image Bank 2005;2005:101279
• Stem Cell Collection (mobilization)
  • Stem cells circulate in the blood
  • Identified by CD34+ by flow cytometry
  • Filgrastim, sargramostim, AMD 3100
  • Stem cells are collected through an apheresis catheter
  • More cells are collected
  • More rapid marrow recovery

Collection of Stem Cells
• Stem cells may be infused fresh within a few hours of collection
• May be frozen using DMSO
  • Creamed corn or garlic smell
• Umbilical cord blood is obtained from one of the umbilical cord veins and frozen with an anticoagulant and nutrient media

Infusion of Stem Cells
100-day Mortality after Autologous Transplants, 2010

Mortality, %

- Early Disease
- Intermediate/Advance Disease
- Sensitive
- Resistant
- Group

Acute Leukemia
Non-Hodgkin Lymphoma
Hodgkin Disease
Multiple Myeloma
Multiple Myeloma
Multiple Myeloma Treatment Lines in Transplant-Eligible Patients

Frontline Treatment
- Induction
  - Bz/Dex
  - Bz/Dex/Dox
  - Bz/Thal/Dex
  - Len/Dex
- Consolidation
- SCT

Maintenance
- Observation
  - Thal
  - Thal/Pred

Relapsed
- Bz
  - Bz/Liposomal Dox
  - Len/Dex

When should HSCT be utilized in the course of a myeloma patient

- SWOG 9321: Overall survival equivalent if used in patients with MM if auto HSCT used as consolidation of first chemotherapy induction (VAD → CTX mobilization) or at time of first progression (after months of VBMCP)
- Recently initiated French-American trial may shed insights on this issue
Melphalan/Prednisone/Lenalidomide (MPR) vs MEL200/ASCT Following Lenalidomide/Dexamethasone (Ld) Induction

n=402 <65 years

Lenalidomide: 25 mg, days 1–21
Low-dose Dex: 40 mg, days 1, 8, 15, 22 q 28 days ×4

Consolidation

MPR (n=202)
Melphalan: 0.18 mg/kg/d, days 1–4
Prednisone: 2 mg/kg/d, days 1–4
Lenalidomide: 10 mg/d, days 1–21 q 28 days ×6

Tandem MEL200
ASCT stem cells mobilized with cyclophosphamide + G-CSF

No maintenance

Maintenance lenalidomide:
10 mg/d,
Days 1–21 q 28 days until relapse

Primary endpoint: PFS

# MPR vs MEL200/ASCT Following Ld Induction:

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<th>MPR</th>
<th>MEL200</th>
<th>P Value</th>
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<tr>
<td><strong>Induction, Best Response</strong></td>
<td><strong>n=358</strong></td>
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<tr>
<td>ORR</td>
<td>84%</td>
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<tr>
<td>CR</td>
<td>5%</td>
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<td>VGPR</td>
<td>32%</td>
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<td><strong>n=79</strong></td>
<td><strong>n=81</strong></td>
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<td>ORR</td>
<td>92%</td>
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<tr>
<td>VGPR</td>
<td>42%</td>
<td>37%</td>
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<td><strong>12-Month Survival</strong></td>
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<tr>
<td>PFS</td>
<td>91%</td>
<td>91%</td>
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<tr>
<td>OS</td>
<td>97%</td>
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*Median F/U = 9 months.  
Outcome with lenalidomide plus dexamethasone followed by early autologous stem cell transplantation in the ECOG E4A03 randomized clinical trial.

David S Siegel², Susanna Jacobus², S. Vincent Rajkumar³, Rafat Abonour⁴, Natalie Callander³, Michael Katz⁵, Rafael Fonseca⁷, David H. Vesole¹ On behalf of the Eastern Cooperative Oncology Group

¹John Thourow Cancer Center, Hackensack, NJ; ²Dana-Farber Cancer Institute, Boston, MA; ³Mayo Clinic, Rochester, MN; ⁴Indiana University School of Medicine, Indianapolis, IN; ⁵University of Wisconsin, Madison, W; ⁶International Myeloma Foundation, Los Angeles, CA; ⁷Mayo Clinic, Scottsdale, AZ;
E4A03: Landmark Analysis at Median Follow-up of 36 mo

431 patients alive at 4 cycles

Off therapy at 4 cycles n=183

- no transplant N=93 (median age 68)
- Transplant n=90 (median age 57)

Primary therapy beyond 4 cycles n=248

- Ld n=140 (median age 66)
- LD n=108 (median age 65)

Rajkumar SV et al. The Lancet Oncology, Volume 11, Issue 1, Pages 29 - 37, January 2010
Outcomes in pts Age <70

Progression Free Survival

Overall Survival
Outcome in pts Age ≥70

Progression Free Survival

Overall Survival
High risk

4 cycles of bortezomib-containing regimen (preferably bortezomib, lenalidomide, dexamethasone [VRd])

Autologous stem cell transplant, especially if not in complete response

Bortezomib-based maintenance therapy

Intermediate risk

4 cycles of bortezomib, cyclophosphamide, dexamethasone (VCd)

Autologous stem cell transplant

Bortezomib-based maintenance therapy

Standard risk

4 cycles of lenalidomide plus low dose dexamethasone (Rd) or bortezomib, cyclophosphamide, dexamethasone (VCd)

Collect stem cells*

Autologous stem cell transplant

Continue Rd* or VCd

Consider second ASCT or lenalidomide maintenance if not in CR after first transplant
Tandem AutoHCT with or without Maintenance Therapy (auto-auto) versus Single AutoHCT Followed by HLA Matched Sibling Non-Myeloablative Allogeneic HCT (auto-allo) for Patients with Standard Risk Multiple Myeloma: Results from the BMT-CTN 0102 Trial


On behalf of the Blood and Marrow Transplant Clinical Trials Network
Introduction

- The prognosis of patients with high-risk myeloma (HR MM) continues to be poor, despite the early incorporation of novel agents.

- Early phase trials of allo HCT suggest the possibility of an immunologic graft-versus-myeloma effect that might favorably affect survival.

- Less toxic nonmyeloablative preparative regimens allow more widespread use of alloHCT in the MM population.
BMT CTN 0102

- Phase III multicenter trial comparing tandem autologous HCT (auto-auto) to an autologous HCT followed by a non-myeloablative allogeneic HCT (auto-allo).

- 710 patients from 43 US centers were enrolled from December 2003 to March 2007.

- Assignment to auto-allo was determined by availability of an HLA-matched sibling donor.

- High Risk was defined as chromosome 13 deletion by metaphase karyotype and beta-2 microglobulin > 4mg/L.

- Primary endpoint-3-year progression-free survival in the standard risk group.
1st Autologous Transplant
N=710

No Sibling Donor
Auto-Auto
N=484

Sibling Donor
Auto-Allo
N=226

High Risk
N=48

Standard Risk
N=436

Standard Risk
N=189

High Risk
N=37

Main groups compared
Survival Outcomes after the First Transplant: Auto-Auto vs. Auto-Allo: Intent-to-treat analysis

Progression-free Survival
- Auto/Auto, 46% @ 3yr
- Auto/Allo, 43% @ 3yr
- p-value = 0.67

Overall Survival
- Auto/Auto, 80% @ 3yr
- Auto/Allo, 77% @ 3yr
- p-value = 0.19

# at risk:
Cumulative Incidence of Disease Progression/Relapse and Treatment-Related Mortality after First Transplant

**Progression/Relapse**
- Auto/Auto, 46% @ 3yr
- Auto/Allo, 40% @ 3yr

**Treatment-related Mortality**
- Auto/Auto, 4% @ 3yr
- Auto/Allo, 12% @ 3yr

*P-value = 0.41*
*P-value < 0.001*
Causes of death according to treatment arms

Auto-Auto

- Myeloma, 70%
- Organ Failure, 15%
- Infection, 2%
- Other, 12%

N=100, 23%

Auto-Allo

- Myeloma, 38%
- Organ Failure, 19%
- Infection, 17%
- GVHD, 11%
- IPS, 6%
- Graft Failure, 2%
- Other, 3%

N=52, 27%
Tandem AutoHCT with or without Maintenance Therapy (auto-auto) versus Single AutoHCT Followed by HLA Matched Sibling Non-Myeloablative Allogeneic HCT (auto-allo) for Patients with High Risk Multiple Myeloma: Results from the BMT-CTN 0102 Trial

Edward A. Stadtmauer, et al.

On behalf of the Blood and Marrow Transplant Clinical Trials Network
Autologous Transplant
N=710

No Sibling Donor
Auto-Auto
N=484

Sibling Donor
Auto-Allo
N=226

Standard Risk
N=436

High Risk
N=48

High Risk
N=37

Standard Risk
N=189

Groups being compared
Survival Outcomes after the First Transplant: Auto-Auto vs. Auto-Allo: Intention-to-treat analysis

Progression-Free Survival

- Auto/Allo, 40% @ 3yr
- Auto/Auto, 33% @ 3yr

Overall Survival

- Auto/Allo, 59% @ 3yr
- Auto/Auto, 67% @ 3yr

P-value = NS

Number at risk:

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<td>Auto/Auto</td>
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<td>30</td>
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<td>18</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>4</td>
<td>4</td>
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Years:
Cumulative Incidence of Disease Progression/Relapse and Treatment-related Mortality after the First Autologous Transplant

**Progression/Relapse**
- Auto/Auto, 50% @ 3yr
- Auto/Allo, 30% @ 3yr

**Treatment-related Mortality**
- Auto/Auto, 11% @ 3yr
- Auto/Allo, 24% @ 3yr

P-value = 0.09
P-value = NS
Survival Outcomes of Auto-Auto vs. Auto-Allo after the First Autologous Transplant: Combined Standard and High Risk Cohorts

Progression-Free Survival

Auto/Auto (n=484), 45% @ 3yr
Auto/Allo (n=226), 42% @ 3yr

Overall Survival

Auto/Allo (n=226), 75% @ 3yr
Auto/Auto (n=484), 79% @ 3yr

P-value = NS
• Allogeneic HSCT is not currently considered as front line therapy for patients with multiple myeloma
• Allogeneic HSCT may remain beneficial as late salvage option
Probability of Survival after Transplants for Multiple Myeloma, 2000-2010
- By Donor Type -

Probability of Survival, %

Years

P < 0.0001

Autologous (N=27,979)

Sibling Donor (N=892)

Unrelated donor (N=380)
AML

- Practice algorithms:
  - Low risk: chemotherapy only
  - High risk: transplantation
  - Intermediate risk: ???
  - Auto vs allo vs chemo → all are options
HOVON/SAKK phase III trial of AML pts in CR1

• Pt population:
  – 519 pts with AML in CR1 after 2 cycles of consolidation therapy
  – Age ≤ 60
  – Not eligible for allo HSCT

• Randomized to consolidation vs BU/cy conditioned auto tx
  – Matched population; ~80% intermediate risk pts in either arm
  – Med follow up over 8 yrs
Results

- 1. Recovery of ANC and plts * autotx
- 2. NRM 4% Auto tx; 1% chemo
- 3. RFS 5 yrs 39% vs 29% *auto tx
- 4. OS 5 yrs 44% vs 40%
- Relapsed pts 5 yr survival
  - 30% if salvage with HCST
  - 3% if salvage with chemo only

* = statistically significant advantage
Summary

• Autologous HCST remains viable option for AML pts
• RFS but not OS impacted
• Cost: benefit decision analysis studies may be performed in the future in decision making re: determination of optimal management algorithms
NCCN Guidelines Version 2.2013
Acute Myeloid Leukemia

RISK STATUS
(See AML-A)

Better-risk cytogenetics and/or molecular abnormalities

POST-REMISSION THERAPY

Clinical trial
or
HIDAC 3 g/m² over 3 h every 12 h on days 1, 3, 5 x 3-4 cycles (category 1)***,***±
or
1 to 2 cycles of HIDAC-based consolidation followed by autologous HSCT,xxx (category 2B)

Intermediate-risk cytogenetics and/or molecular abnormalities

Clinical trial
or
Matched sibling or unrelated donor HSCT,xxx
or
HIDAC,xxx 1.5-3 g/m² over 3 h every 12 h on days 1, 3, 5 x 3-4 cycles
or
1 to 2 cycles of HIDAC-based consolidation followed by autologous HSCT

Treatment-related disease or poor-risk cytogenetics and/or molecular abnormalities***,xxx

Clinical trial
or
Matched sibling or alternative donor HSCT,xxx

Age <60

See Surveillance (AML-1A)

See Surveillance (AML-1A)

See Surveillance (AML-1A)

**Begin alternate donor search (unrelated donor or cord blood) if no appropriate sibling donor is available and the patient is a candidate for an allogeneic HSCT.
**FLT3-ITD mutations are also emerging as a poor-risk feature in the setting of otherwise normal karyotype; and these patients should be considered for clinical trials where available. There is controversy regarding allogeneic transplant for FLT3-ITD-only mutations in the absence of other poor prognostic features.


Note: All recommendations are category 2A unless otherwise indicated.
Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.
Autologous Transplant for AL amyloidosis, Gertz et al, 2010

• 434 pts auto tx between 1996-2010
• Most critical determinants of outcome: stage of amyloidosis
• Factors that can influence stage: BNP and troponin levels
• Targets: proBNP <332 and troponin < .035
• Staging I- both low; II- single elevation; III- both elevated
Autologous HSCT for AL amyloidosis, Gertz et al, 2010

Cardiac: Stage 1-3 stratified by BNP/Troponin

Differential of involved Free light chains < or > 13.5 mg/dl
Other studies:

1. Outcomes since 2006 are improved, primarily associated with lower TRM in first 100 days

2. Higher plasma cell burden on presentation (>10%) had worse outcomes, mostly due to higher cardiac burdens

3. Response to autologous HSCT correlates with survival
NCCN Guidelines Version 2.2013
Hodgkin Lymphoma

CLASSICAL HODGKIN LYMPHOMA

SECOND-LINE THERAPY

Refactory disease

Second-line chemotherapy

Deauville 1-3°

Deauville 4°

Deauville 5°

HDT/ASCR

Observe

RT

Salvage chemotherapy

Brentuximab vedotin

HDT/ASCR

Deauville 1-4°

Deauville 5°

HDT/ASCR

Deauville 1-4°

Deauville 5°

HDT/ASCR

Observe

RT

Salvage chemotherapy

Brentuximab vedotin

Deauville 1-4°

Deauville 5°

Additionalexplanation:

See Principles of Radiation Therapy (HODG-C).

Biopsy to confirm histology. Clinical circumstances may warrant additional treatment even in face of negative biopsy.

See Deauville PET Criteria (HODG-D).

Deauville 3 should have short interval follow-up including PET-CT.

There are no data to support a superior outcome with any of the treatment modalities. Individualized treatment is recommended.


Conventional-dose chemotherapy may precede high-dose therapy. Timing of RT may vary.

Radiation therapy recommended when sites have not been previously irradiated. In a radiation-naive patient, TLI may be an appropriate component of HDT.

Allo transplant is an option in select patients as a category 3 recommendation.

Brentuximab vedotin is a treatment option for patients who have failed HDT/ASCR or at least 2 prior multi-agent chemotherapy regimens.

Note: All recommendations are category 2A unless otherwise indicated.

Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.
Probability of Survival after Autologous Transplants for Hodgkin Disease, 2000-2010
- By Disease Status -

CR (N=2,907)
Not in CR, sensitive (N=3,832)
Not in CR, resistant (N=1,237)

P < 0.0001
Follicular Lymphoma (grade 1-2)

HISTOLOGIC TRANSFORMATION TO DIFFUSE LARGE B-CELL LYMPHOMA

Multiple prior therapies

- Clinical trial
- Radioimmunotherapy
- Chemotherapy (See BCEL-C)
  - rituximab
- IFRT
- Best supportive care (See NCCN Guidelines for Palliative Care)

Responsive disease
- Consider high-dose therapy
  - with autologous stem cell rescue or allogeneic stem cell transplant

Histologic transformation to diffuse large B-cell lymphoma

Minimal or no prior chemotherapy

- Chemotherapy (anthracycline-based chemotherapy preferred unless contraindicated) (See BCEL-C) + rituximab
  - RT

CR
- Observation
- Clinical trial
- Consider high-dose therapy with autologous stem cell rescue or allogeneic stem cell transplant

PR
- Consider high-dose therapy with autologous stem cell rescue or allogeneic stem cell transplant

NR or progressive disease
- Clinical trial
- Radioimmunotherapy
- Palliative or best supportive care

Consider prophylaxis for tumor lysis syndrome (See NHODG-B)

See monoclonal antibody and viral reactivation (NHODG-B)

1See Response Criteria for Non-Hodgkin's Lymphoma (NHODG-C).
2Involved-field RT alone or one course of single-agent therapy including rituximab.
3If locoregional transformation, consider adding RT.
4Strongly recommend this treatment be given in the context of a clinical trial; nonmyeloablative approaches may also be considered.

Note: All recommendations are category 2A unless otherwise indicated.

Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.
Survival after Autologous Transplants for Follicular Lymphoma, 2000-2010
- By Disease Status -

Probability of Survival, %

Sensitivity (N=2,676)
Resistant (N=279)

P < 0.0001
NCCN Guidelines Version 2.2013
Diffuse Large B-Cell Lymphoma

INTERIM RESTAGING

FOLLOW-UP THERAPY

END OF TREATMENT RESTAGING

INITIAL RESPONSE (after completion of induction chemotherapy)

FOLLOW-UP

Stage III, IV:
After 2-4 cycles, restage to confirm response

Responding disease → Continue RCHOPq to a total of 6 cycles or Clinical trial

No response or progressive disease → See Additional Therapy for Relapse (BCEL-6) or RT in select patients who are not candidates for chemotherapy

At completion of treatment, repeat all positive studies. If PET-CT scan positive, rebiopsy before changing course of treatment.

Complete response (PET negative)

Partial response^ (PET positive)

No response or progressive disease

Clinical
- H&P and labs, every 3-6 mo for 5 y and then yearly or as clinically indicated
- CT scan no more often than every 6 mo for 2 y after completion of treatment, then only as clinically indicated

Relapse, See Relapse/Refractory Disease (BCEL-6)

Note: All recommendations are category 2A unless otherwise indicated.
Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.
Probability of Survival after Autologous Transplants for Diffuse Large B-Cell Lymphoma, 2000-2010

By Disease Status

Sensitivity

Resistant (N=1,033)

Sensitive (N=8,891)

Probability of Survival, %

P < 0.0001

Years
NCCN Guidelines Version 2.2013
Mantle Cell Lymphoma

INDUCTION THERAPY

INITIAL RESPONSE

CONSOLIDATION

FOLLOW-UP

RELAPSE

SECOND-LINE THERAPY

Candidate for HDT/ASCRT

Complete response

Clinical trial

Not candidate for HDT/ASCRT

High-dose therapy with autologous stem cell rescue

Rituximab maintenance (category 1)
(See MANT-A)

Clinical follow-up every 3-6 mo for 5 y and then yearly or as clinically indicated

Relapse

Treated with RCHOP

Not treated with RCHOP

CR/Improved PR

No further response

Consider second-line therapy (See MANT-A)

Partial response

Consider prophylaxis for tumor lysis syndrome (See NHODG-B)

Clinical trial or See Suggested Regimens (MANT-A)

Stage II*, III, IV

Clinical trial or See Suggested Regimens (MANT-A)

Partial response

Consider prophylaxis for tumor lysis syndrome (See NHODG-B)

Clinical trial or See Suggested Regimens (MANT-A)

Progression

Clinical trial or Second-line treatment

- RT
- See Suggested Regimens (MANT-A)

Note: All recommendations are category 2A unless otherwise indicated.
Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.

1 Early referral for high-dose therapy with stem cell rescue is advisable for planning purposes.
2 See Response Criteria for Non-Hodgkin's Lymphoma (NHODG-C).
3 Option for clinical trials of adjuvant therapy or for relapsed disease involving high-dose therapy with autologous stem cell rescue or allogeneic stem cell transplant, immunotherapy with nonmyeloablative stem cell rescue, or evaluation of treatment with new agents are appropriate.
Probability of Survival after Transplants for Mantle Cell Lymphoma, 2000-2010
- By Donor Type -

![Graph showing the probability of survival after transplants for mantle cell lymphoma by donor type (2000-2010). The graph compares survival rates for sibling donors, unrelated donors, and autologous transplants. The x-axis represents years (0-6), and the y-axis represents the probability of survival (%). The survival rates are significantly different among the groups, with a statistical significance of P < 0.0001.](SUM12_20.ppt)
“Diseases desperate grown
By disparate appliance
Are reliev’d,
Or not at all”

*After Shakespeare*
Thank You...